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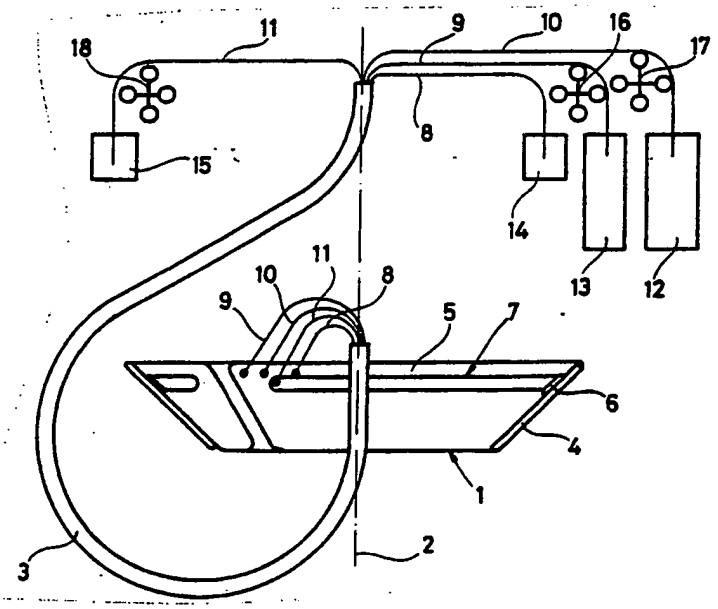

(57) Abstract

In a centrifuge rotor there is formed a separation chamber (4) having an inlet (24) for a mixture of components to be separated and two outlets (21, 23) for the respective separated components. A partition means (7) is arranged to divide the separation chamber (4) in two elongated compartments (29, 30) situated at different distances from the rotor axis. Means is arranged to displace separated heavy component in the circumferential direction of the rotor through the radially outer one of said compartments to and out through the outlet (23) for heavy component.

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Centrifugal separator

The present invention relates to a centrifugal separator comprising a rotor having a separation chamber, an inlet to the separation chamber for a liquid mixture of components to be separated, two outlets from the separation chamber for a separated light component and a separated heavy component of the mixture, and means for the supply of mixture to the separation chamber through said inlet and removal of separated components from the separation chamber through said outlets during rotation of the rotor.

It is relatively easy by means of centrifugal force continuously to separate and discharge from a centrifuge rotor two low viscous mixture components. There are centrifugal separators of different kinds available for such separation even when the components are vulnerable and have to be treated very gently. For instance there are centrifugal separators having a rotor with hermetically closed inlets and outlets. A particular technique even makes it possible to transfer liquids to and from a rotating centrifuge rotor without the use of so called rotating seals. In this connection reference is made to for instance US-A 3,358,072, US-A 3,586,413, US-A 4,108,353 and SE 7708858-1.

It is much more difficult continuously to separate and remove from a centrifuge rotor two mixture components, one of which is relatively viscous. In such cases a separation method often has to be used, in which the separated less viscous component is continuously discharged from the centrifuge rotor, whereas the separated more viscous component is accumulated therein. It is true that there are centrifuge rotors arranged for intermittent discharge of accumulated such viscous components during operation through peripheral outlets of the separation chamber, but centrifuge rotors of this kind are not usable if the component in question is vulnerable and has to be treated gently.

The object of the present invention is to provide a centrifugal separator which is suitable for the separation of two mixture components, a separated light liquid component being continuously discharged from the rotor, whereas a separated heavy component, that is relatively viscous and vulnerable, is discharged intermittently from the rotor in a gentle way.

This object can be achieved by means of a centrifugal separator of the initially defined kind, which is characterized according to the invention by a partition means arranged to divide the separation chamber in two compartments extending beside each other in the peripheral direction of the rotor, one of which compartments is located at a larger distance from the rotor axis than the other and is connected to the outlet for separated heavy component of the mixture; equipment arranged to move during the rotation of the rotor said partition means between two positions, a first position in which the compartments communicate with each other along their common extension in the peripheral direction of the rotor, and a second position in which the compartments are separated from each other at least along the main part of their common extension; and means arranged during the rotation of the rotor, while the partition means is situated in said second position, to move separated heavy component in the circumferential direction of the rotor through said one compartment towards and out through the outlet for this component.

In a centrifugal separator of this kind a gentle intermittent discharge of separated heavy component from the separation chamber of the rotor is achievable even if the separation chamber has a large extension in the circumferential direction of the rotor. A separation chamber having an elongated form like this is sometimes desirable, since it offers a relatively long flow way for the mixture under centrifugation across the centrifugal field generated in the rotor. A separation chamber having

this form is proposed for instance in the above mentioned SE 7708858-1, it being presumed, however, for the removal of the separated heavy component that this has a relatively low viscosity, so that it can flow by its own force in the circumferential direction of the rotor to the outlet therefor.

For the displacement of the separated heavy component means of different kinds may be used. For instance a pressure fluid may be used for gradual displacement of the component in the circumferential direction of the rotor. The partition means may be arranged to separate the two compartments in the separation chamber entirely, the pressure fluid preferably being kept separate from the heavy component by means of a flexible partition in the rotor. Alternatively, the partition means may be formed such that in its dividing position in the separation chamber it leaves a connection between the two compartments situated at a distance from the outlet for separated heavy component, seen in the circumferential direction of the rotor. Thereby, mixture supplied at an overpressure to the separation chamber - or returned separated light component of the mixture - may be used as a pressure fluid for the displacement of separated heavy component

In a preferred embodiment of the invention the separation chamber is formed by a separation bag of flexible material, which is removably mounted in the rotor, the partition means being arranged for squeezing of the separation bag. The partition means may be constituted by a separate, elongated, expandable pressure bag arranged to be connected intermittently to a pressure fluid source.

An expandable elongated pressure bag of this kind may be used, if desired, even as a partition means within a separation chamber that has non-flexible surrounding walls.

The invention is described below with reference to the accompanying drawing, in which

Fig 1 schematically shows a centrifuge rotor having means for transferring of liquid to and from itself,

Fig 2 shows a separation bag and a pressure bag of flexible material, which may be mounted in a centrifuge rotor according to fig 1,

Fig 3 shows a radial section of a part of a centrifuge rotor according to fig 1,

Fig 4 shows a radial section through the bags in fig 2 in the form which they have when they are mounted in a centrifuge rotor,

Fig 5, 6; 7, 8; and 9, 10 illustrate various particular embodiments of the invention.

In the different figures the same reference numerals have been used for corresponding details, sometimes with the addition of a letter.

Fig 1 shows a centrifuge rotor 1, which is rotatable around a vertical axis 2. A flexible tube 3 is connected with the rotor 1 and extends out from its underneath side at the axis 2, further around the peripheral portion of the rotor to an area near the axis 2 at the upper side of the rotor, where it is connected with a stationary member, that is not shown in the drawing. The rotor 1 is rotatable by means of an apparatus (not shown) of some conventional kind, for instance of the kind as shown in US-A 4,108,353, the tube 3 being arranged to rotate around the rotor in the same direction as the latter but only at half of its speed so that it cannot be twisted.

Within the rotor between two frusto-conical walls a separation chamber 4 is formed, which extends almost around the axis 2. The separation chamber is formed by an elongated separation bag 5 of flexible material, which is releasably mounted in the rotor and which is shown in fig 2 unrolled on a plane support. In the rotor there is also defined another smaller chamber 6, which extends along the separation chamber 4 in the circumferential direction of the rotor. The chamber 6 is formed by a separate elongated pressure bag 7 of flexible material, which abuts along the whole of its extension against the outside of the separation bag 5. The pressure bag 7 is shown in dotted lines in fig 2.

Through the flexible tube 3 there are extending four flexible hoses 8-11, of which the hoses 8-10 at their ends in the rotor are firmly connected with one and the same end of the separation bag 5, whereas the hose 11 at its end in the rotor is firmly connected with the adjacent end of the pressure bag 7. At their other ends the hoses 8-11 are connected with each of four stationary containers 12-15. Between the stationary end of the tube 3 and the respective containers 12-15 each of the hoses 9-11 extends through a so called hose pump 16, 17 and 18, respectively. At the corresponding place the hose 8 preferably is provided with a closing valve (not shown).

As illustrated in fig 2 opposing walls of the separation bag 5 are united for instance by heat sealing along a line 19. Hereby the separation chamber 4 is closed off along a large part of its extension in the circumferential direction of the rotor from connection with a channel 20, to one end of which the interior of the hose 9 is connected. Only at a relatively small area 21 at the opposite end of the channel 20 the latter communicates with the separation chamber 4.

Even along a line 22 the opposing walls of the separation bag 5 are united with each other, so that separate connection channels

23 and 24 are formed in the bag between the separation chamber 4 and the respective connection places at the bag for the hoses 8 and 10.

Fig 2 illustrates by means of an arrow a preferred rotational direction for the separation bag 5, i.e. for the rotor 1.

Fig 3 shows a part of a rotor according to fig 1, comprising two rotor parts 25 and 26, which are kept together axially by means of a lock ring 27. Between the rotor parts 25 and 26 there is formed a space 28, in which a separation bag 5 and a pressure bag 7 according to fig 1 and 2 are intended to be placed. A radial cross-section through the bags 5 and 7 in the form which they would have in the space 28 is shown in fig 4. As can be seen, the pressure bag 7 is shown in an expanded state such that it squeezes together the opposing walls of the separation bag 5. Hereby the separation chamber within the separation bag 5 is divided in two compartments 29 and 30, which are situated at different distances from the rotor axis 2.

From fig 2 it can be seen that the pressure bag 7 by its extension along only a part of the separation bag 5 will leave in an expanded state a small area 31, at which the two compartments 29 and 30 communicate with each other. This area is located at a substantial distance - seen in the circumferential direction of the rotor 1 - from the place of connection of the hose 8 to the separation bag 5. The interior of the hose 8 communicates through the channel 23 with the compartment 29 in the separation bag 5, when the pressure bag 7 is expanded. The pressure bag 7 in its expanded state accomplishes sealing between the compartments 29 and 30 all the way to the connection line 22.

As can be seen from fig 3 the rotor part 26 has three parallel recesses 32 open towards the space 28 and extending in the

circumferential direction of the rotor. The two outer ones of these are intended to be housing two weld joints 33 of the pressure bag 7 for its fixation (fig 4), whereas the intermediate recess is intended to be housing a central part of the pressure bag 7 for facilitating of its emptying of pressure fluid.

The centrifugal separator according to fig 1-4 is intended to operate in the following manner.

After the pressure bag 7 has been drained at least partly from contained liquid by means of the pump 18, and the rotor 1 has been brought into rotation, a liquid mixture is pumped from the container 12 by means of the pump 17 through the hose 10 into the separation chamber 4 of the separation bag 5. This mixture of components to be separated flows in the circumferential direction of the rotor from one end to the other of the separation bag 5. At this stage the separation chamber 4 comprises both the compartments 29, 30, since the pressure bag 7 is not expanded and, therefore, the compartments 29 and 30 communicate with each other along the whole of the separation bag 5. The closing valve (not shown) in the hose 8 is closed.

During the flow through the separation bag 5 a relatively light component is separated by the centrifugal force from a relatively heavy component of the mixture. It is presumed that the light component is constituted by a low viscous liquid, whereas the heavy component is constituted by particles, for instance cells of some kind, which themselves or together with a small amount of the liquid form a rather viscous mass. Such a mass is depositing gradually in the radially outermost part of the separation chamber 4, while liquid freed from particles flows furtheron through the separation bag 5.

When the separated light component has reached the opposite end of the separation bag 5, it flows through the connection 21 radially inwards to the channel 20 and continues therethrough in the circumferential direction of the rotor back to the first end of the separation bag 5. There it leaves the separation bag through the hose 9 and is pumped further on by means of the pump 16 to the container 13.

When after some time of centrifugation a certain amount of heavy component has deposited in the radially outermost part of the separation chamber 4 the pump 18 is activated, so that liquid with an overpressure is supplied to the pressure bag 7. This then expands to a state, as shown in fig 4, in which it compresses the separation bag 5 and creates the compartments 29 and 30, which communicate with each other only in the area 31 (fig 2). The liquid pressure in the pressure bag 7 should exceed the pressure in the separation bag 5 substantially.

When the pressure bag 7 is expanded, the valve (not shown) in the hose 8 is opened, and the pump 16 is stopped, so that it prevents further outflow of separated light component from the separation bag 5. This means that the liquid pressure, which is then generated by the pump 17 in the compartment 30 of the separation bag 5, to which the interior of the hose 10 is connected, propagates to the compartment 29 through the connection 31. Thereby it is achieved that the viscous separated heavy component, which at this stage fills the compartment 29, is pressed out through the channel 23 and the hose 8 to the container 14. More or less separated liquid from the compartment 30 thus displaces heavy component along the compartment 29 in the circumferential direction of the rotor from the connection 31 to the channel 23.

When a desired amount of heavy component has been removed from the separation bag 5, the valve in the hose 8 is again closed

and the pump 18 is reversed simultaneously as the pump 16 is started. Then the pressure bag 7 collapses and the whole separation chamber 4 is again available for a new separation period.

It is realized that the removal of the heavy component from the compartment 29 could alternatively be accomplished by stopping of the pump 17 for new mixture and reversing of the pump 16 for separated light component.

It is further realized that in an arrangement of pumps according to fig 1 the pumps 16 and 17 have to be operated with capacities, which are exactly adjusted in relation to each other with reference to the content of heavy component present in the supplied mixture. As this content may vary and/or be difficult to foresee, it is often more suitable instead of the pump 16 to arrange a pump for intermittent pumping of separated heavy component out through the hose 8. The pump 17 is thus used both for the supply of mixture through the hose 10 and for the discharge of separated light component through the hose 9. The pump 17 in this case need not be used in connection with the intermittent removal of heavy component from the separation bag 5 but may stand still during these periods of time. If the pump 17 although should be used for facilitating the discharge of heavy component, the hose 9 has to be provided with a closing valve, so that an overpressure can be built up in the separation chamber 4 for said discharge.

Fig 5 and 6 illustrate an alternative embodiment of the invention. The separation bag 5 and the hoses 8-10 connected therewith are shown in dotted lines. A pressure bag 7a - corresponding to the pressure bag 7 in fig 1-4 - is connected to a hose 11a. It is presumed that the bags 5 and 7a are arranged in a space in a rotor in the manner described above in connection with fig 3 and 4.

Opposing walls of the pressure bag 7a are united by heat sealing along a line 34, which extends all the way from one end of the pressure bag to a short distance from the other end thereof. Thus, two parallel channels 35 and 36 are formed which extend in the circumferential direction of the rotor at different distances from the rotor axis. At said first end of the pressure bag the hose 11a is connected to the channel 35, and at the other end the channels 35 and 36 communicate with each other through an opening 37.

At several places along its extension the radially outer channel 36 has throttles 38 formed by heat sealing of parts of the channel walls.

The device according to fig 5 and 6 is intended to operate in the following manner.

After centrifugation has been going on some time with the supply of liquid mixture through the hose 10 and discharge of separated light component through the hose 9, a separate liquid having an overpressure is supplied through the hose 11a to the channel 35 in the pressure bag 7a. Then the part of the pressure bag 7a forming the channel 35 and the opening 37 at the end of the pressure bag is expanded, which makes that the opposing walls of the separation bag 5 are squeezed together - as in fig 4 - along a line opposite to the channel 35 in the pressure bag 7a. Separate compartments - similar to the compartments 29 and 30 in fig 4 - thereby are formed in the separation bag 5, which compartments are lacking any connection with each other, however, as a consequence of the fact that the separation bag 5 is pressed together even at the area opposite to the opening 37 in the pressure bag 7a.

Upon continued supply of liquid at an overpressure to the channel 35 this liquid forces its way successively through the

throttles 38, the radially outer closed compartment of the separation bag 5 - corresponding to the compartment 29 in fig 4 - being gradually compressed. The separated heavy component present in the closed compartment thereby is pressed in the circumferential direction of the rotor towards the end of the compartment and out through the hose 8.

Fig 7 and 8 illustrate one further embodiment of the invention. Even here the separation bag 5 is shown in dotted lines. A pressure bag 7b - corresponding to the pressure bag 7a in fig 6 - is connected to a hose 11b. Even here it is presumed that the bags 5 and 7b are arranged in a space in a rotor in the manner described above in connection with fig 3 and 4.

The pressure bag 7b has a radial extension that is substantially of the same magnitude as that of the pressure bag 7a but it is not like the latter divided in different parallel channels. The pressure bag 7 has radially inner and outer limiting walls 39 and 40 and extends in the circumferential direction of the rotor all the way from an area at one end of the separation bag 5 - between the connections of the hoses 8 and 10 to the latter - to the other end of the separation bag 5. For the expansion of the pressure bag 7b the latter is supposed to be charged with a pressurized gas instead of liquid.

The device according to fig 7 and 8 is intended to operate in the following manner.

After centrifugation has been going on some time with a supply of liquid mixture through the hose 10 and with a removal of separated light component through the hose 9, pressurized air is gradually supplied through the hose 11b to the pressure bag 7b. Since the liquid pressure generated in the separation bag 5 by centrifugal force is lower at the area of the inner limiting wall 39 of the pressure bag 7b than at the area of the outer

limiting wall 40, but the air pressure in the pressure bag 7b at each moment has the same value in all parts of the pressure bag, the pressure bag 7b upon gradual increasing air pressure will expand in a manner such that it will first squeeze together the separation bag 5 along the area of the inner limiting wall 39 and then - with an increasing air pressure - radially outwards towards the area of the outer limiting wall 40. Hereby separated heavy component having collected in the radially outermost part of the separation bag 5 will gradually be displaced radially outwards, and since there is only one way out of the separation bag 5 for the heavy component, it will flow in the circumferential direction of the rotor towards and out through the hose 8.

Instead of one single pressure bag 7b two separate pressure bags may be used, which are separately connected either to one and the same overpressure source or to different overpressure sources. Two such separate pressure bags may extend as the channels 35 and 36 in the pressure bag 7a according to fig 6. Upon use of two separate pressure bags instead of one it will be easier separately to control the two different operational steps 1) division of the separating chamber in two compartments and 2) removal of the separated heavy component from one of these compartments.

Fig 9 and 10 illustrate a further embodiment of the invention. A separation bag 5a - corresponding to the separation bag 5 in fig 1-8 - is shown in dotted lines, and it is presumed that it is arranged in a space in a rotor in the same manner as described previously in connection with fig 3 and 4.

A further pressure bag, corresponding to the bags 7, 7a and 7b in the previously described embodiments, in this case has a different extension. The pressure bag in question, which is entirely closed and is lacking connection to any hose, has a

first part 41 extending in the same way as the pressure bag 7 in fig 2 and a second part 42 extending in parallel with the bag part 41 radially inside thereof at the area of a channel 20a in the separation bag 5a. The channel 20a corresponds to the channel 20 of the separation bag 5 in fig 1 but it has a strongly throttled connection 21a with the separation chamber 4a in the rest of the separation bag 5a.

The bag parts 41 and 42 communicate with each other through a radially extending third bag part 43.

The device according to fig 9 and 10 is intended to operate in the following manner.

Through the hose 10a the separation chamber 4a is charged by overpressure with a liquid mixture of components to be separated. The mixture flows clockwise in the circumferential direction of the rotor through the separation chamber 4a, heavy component being separated and gradually depositing in the radially outermost part of the separation chamber. Separated light component flows furtheron to the opposite end of the separation chamber 4a and passes through the throttled connection 21a into the channel 20a. Therein it flows in the opposite direction against the flow in the separation chamber 4a to and out through the hose 9a. Depending upon the throttle 21a the pressure in the channel 20a is lower than that in the separation chamber 4a. A pump (not shown) for pumping out of separated light liquid component from the channel 20a - corresponding to the pump 16 in fig 1 - may be used so that it contributes to generating this pressure difference.

As a consequence of the overpressure thus prevailing in the separation chamber 4a the latter is expanded so heavily that it squeezes together the bag part 41 and, thereby, presses liquid out thereof and through the bag part 43 to the bag part 42.

This is possible because of the fact that the bag part 42 is situated at the area of the channel 20a, in which as mentioned above there is prevailing a lower pressure than in the separation chamber 4a.

After a certain amount of heavy component has been collected in the separation chamber 4a, the pump that has been pumping new mixture into the separation chamber is stopped, and the above pump having pumped separated light component out of the channel 20a is reversed. Upon return pumping of separated light component there will arise an overpressure in the channel 20a, which as a consequence of the throttled connection 21a is larger than the pressure in the separation chamber 4a. The result thereof will be that the part of the separation bag 5, which forms the channel 20a, expands and squeezes together the bag part 42, so that liquid in the latter flows over into the bag part 41 through the bag part 43. The bag part 41 thereby expands, so that it squeezes together the separation bag 5 and causes a division of the separation chamber 4a into two compartments similar to the compartments 29 and 30 in fig 4. These compartments communicate with each other only through the connection 31a.

Upon a continued return pumping of separated light component it flows further on through the throttle 21a into the separation chamber 4a and from there through the connection 31a into the radially outer one of the two formed compartments. Then it presses separated heavy component, which is filling this outer compartment, in the circumferential direction of the rotor towards and out through the hose 8a.

In all of the embodiments of the separation bag, which have been described above, two opposing walls of the bag are united along a line 19, so that an outlet channel 20 is formed, which extends in parallel with the separation chamber radially inside thereof.

This construction of the separation bag has been chosen only to enable connection of all the hoses 8-10 at the same end of the separation bag. This is of course not necessary. Instead, the connection along the line 19 may be disposed of, and the hose 9 for removal of separated light component may be connected with the opposite end of the separation bag.

A number of embodiments of the invention have been described above, according to which the separation chamber in the centrifuge rotor is formed by a separation bag of flexible material. This is not necessary. The space 28 with rigid walls, shown in fig 3, may form a separation chamber, and a pressure bag - similar to the pressure bag 7 in fig 4 - may be arranged to divide the separation chamber in compartments similar to the compartments 29 and 30 in fig 4.

As dividing or partition means may be used instead of such a pressure bag any suitable means, for instance a hydraulically controllable, axially movable slide member, which is known from rotors in other kinds of centrifugal separators.

Further, it is not necessary to use hoses like the hoses 8-11 for the connections between various chambers in the rotor and stationary containers. Alternatively, it is possible to use rotating couplings, comprising mechanical seals, for the connection of different stationary conduits to a rotatable rotor. In other words, it is not necessary to use a device for driving of the rotor of the kind comprising a flexible tube similar to the tube 3 in fig 1, which is rotatable around the rotor.

Upon operation of a centrifugal separator according to the invention it may sometimes be advantageous to use a different method of operation than the one described above. Upon separation of for instance cells it may thus be suitable to

perform the separating operation while the separation chamber is divided in two compartments 29 and 30, as illustrated in fig 4. Then separated cell mass will be collected in the radially outermost part of the compartment 30. When a sufficient amount of cell mass has been separated in the compartment 30, the connection between the compartments 39 and 40 is opened, so that the cell mass will move radially outwards and fill up the compartment 29. Immediately after this the connection between the compartments 29 and 30 is reclosed, upon which the cell mass in a manner as described above is moved in the circumferential direction of the rotor towards the outlet of the compartment 29 and out therethrough. When the separated cell mass in this way has been removed from the rotor, the discharge operation is interrupted and the separating operation may continue with the connection between the compartments 29 and 30 closed.

By such a method of operating the centrifugal separator according to the invention it is achieved that the cell mass having been separated in the separation chamber and having been packed during a relatively long time, is given somewhat better flowability immediately before the discharge operation, during which it should be displaced along the compartment 29 and out of the rotor.

Claims

1. Centrifugal separator comprising a rotor having a separation chamber (4), an inlet (24) to the separation chamber for a liquid mixture of components to be separated, two outlets (21, 23) from the separation chamber for a separated light component and a separated heavy component of the mixture, and means for the supply of mixture to the separation chamber through said inlet and removal of separated components from the separation chamber through said outlets during rotation of the rotor, c h a r a c c t e r i z e d b y

- partition means (7) arranged to divide the separation chamber (4) in two compartments (29, 30) extending beside each other in the circumferential direction of the rotor, one (29) of which compartments is situated at a larger distance from the rotor axis (2) than the other and is connected to the outlet (23) for a separated heavy compoment of the mixture;

- equipment (18) arranged during the rotation of the rotor to move the partition means (7) between two positions, a first position in which the compartments (29, 30) communicate with each other along their common extension in the circumferential direction of the rotor, and a second position in which the compartments are separated from each other at least along the main part of their common extension; and

- means arranged during the rotation of the rotor, while the partition means (7) is situated in said second position, to move separated heavy component through said one compartment (29) in the circumferential direction of the rotor towards and out through the outlet (23) for this component.

2. Centrifugal separator according to claim 1, c h a r a c - t e r i z e d i n that the partition means (7) is arranged in its said second position in the separation chamber to leave a connection (31) between the two compartments (29, 30), situated at a distance from the outlet (23) for separated heavy component, seen in the circumferential direction of the rotor.

3. Centrifugal separator according to claim 1 or 2, c h a - r a c t e r i z e d i n that the partition means and the equipment for moving of the partition means comprises an elongated expandable pressure bag (7) arranged intermittently to be connected to a pressure fluid source.

4. Centrifugal separator according to any of the preceding claims, c h a r a c t e r i z e d i n that the inlet (24) for liquid mixture and the outlet (23) for separated heavy component are situated at a first end and the outlet (21) for separated light component is situated at another end of the separation chamber (4) - seen in the circumferential direction of the rotor - the inlet for liquid mixture being connected to said other compartment (30) of the separation chamber (4) when the latter is divided.

5. Centrifugal separator according to any of the preceding claims, c h a r a c t e r i z e d i n that the separation chamber (4) is formed by a separation bag (5) of flexible material, which is releasably mounted in the rotor.

6. Centrifugal separator according to claim 5, c h a r a c - t e r i z e d i n that the partition means (7) is arranged for squeezing of the separation bag (5).

7. Centrifugal separator according to claim 4, in which the separation chamber (4) is formed by a separation bag (5) of flexible material, c h a r a c t e r i z e d i n that

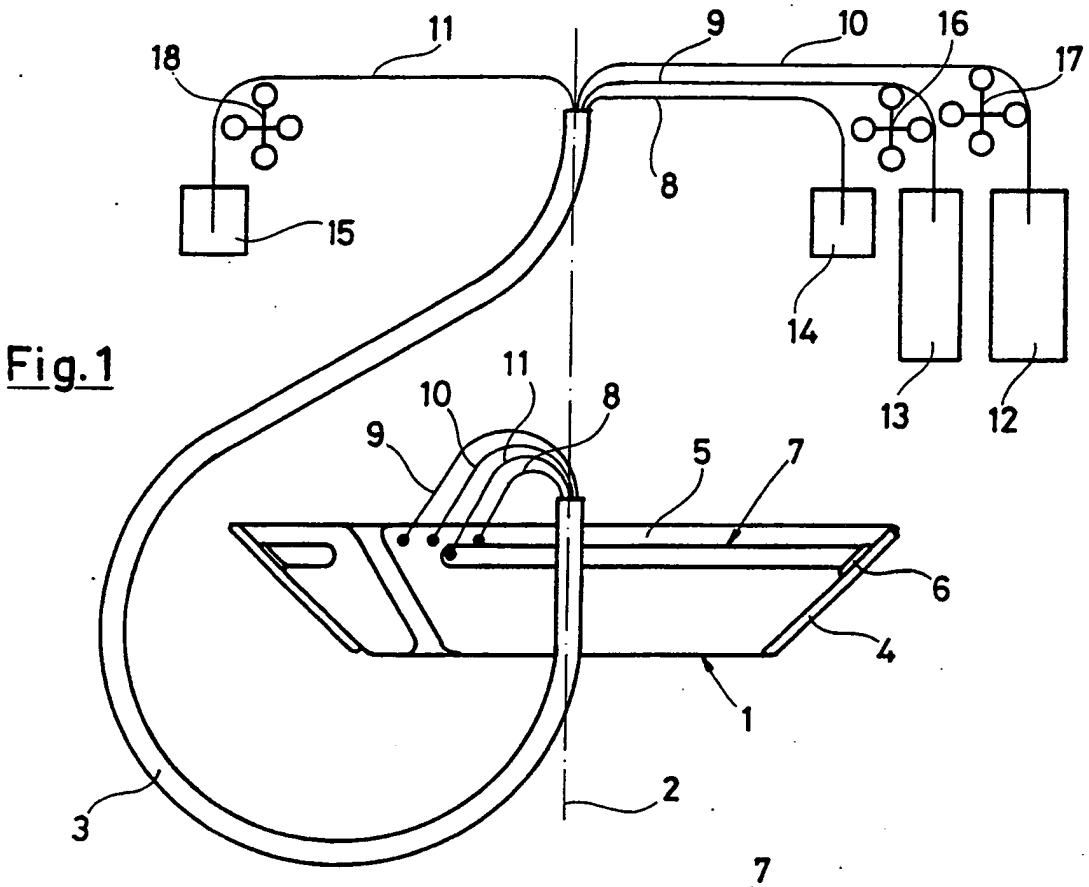
the separation bag (5) is connected in one piece with an inlet and outlet device forming an inlet channel (10), that is connected to the inlet of the separation chamber, and two outlet channels (8, 9), which are connected to the respective outlets of the separation chamber; that the inlet and outlet device is connected with the separation bag (5) at the end of the separation chamber (4), at which its inlet (24) for liquid mixture and outlet (23) for separated heavy component are situated; and that opposing parts of the walls of the separation bag (5) are connected with each other along at least one line (19) extending in the circumferential direction of the rotor such that a channel (20) is formed within the separation bag, which is separated from the separation chamber (4) and which at one of its ends communicates with an outlet channel (9) in the inlet and outlet device and at its other end communicates with the outlet (21) of the separation chamber for separated light component.

8. Centrifugal separator according to any of the preceding claims, c h a r a c t e r i z e d i n that said means for moving of separated heavy component in the circumferential direction of the rotor through said one compartment (29) comprises a pump so connected to the separation chamber (4) that upon operation of the pump a pressure difference arises between the ends of the compartment.

9. Centrifugal separator according to any of the preceding claims, c h a r a c t e r i z e d i n that said means for moving of separated heavy component in the circumferential direction of the rotor through said one compartment (29) comprises a displacement member (7a, 7b) movable into the space of said compartment to displace the heavy component out thereof.

10. Centrifugal separator according to claim 9, c h a r a c - t e r i z e d i n that the displacement member (7a, 7b) constitutes part of a partition means, which is arranged to divide the separation chamber (14) in said two compartments (29, 30), before it is movable for displacement of said separated heavy component.

11. Centrifugal separator according to any of the preceding claims, c h a r a c t e r i z e d i n that said means for supply of mixture to the separation chamber and discharge of separated components from the same comprises at least one flexible member (3), which defines an inlet channel (10) connected to said inlet and two outlet channels (8, 9) connected to the respective outlets of the separation chamber and which flexible member is connected with the rotor, extends out from the rotor at its rotational axis (2) on one side of the rotor, extends further outside the periphery of the rotor to said rotational axis (2) on the other side of the rotor and is firmly connected with a non-rotatable device for supply of mixture and reception of separated components.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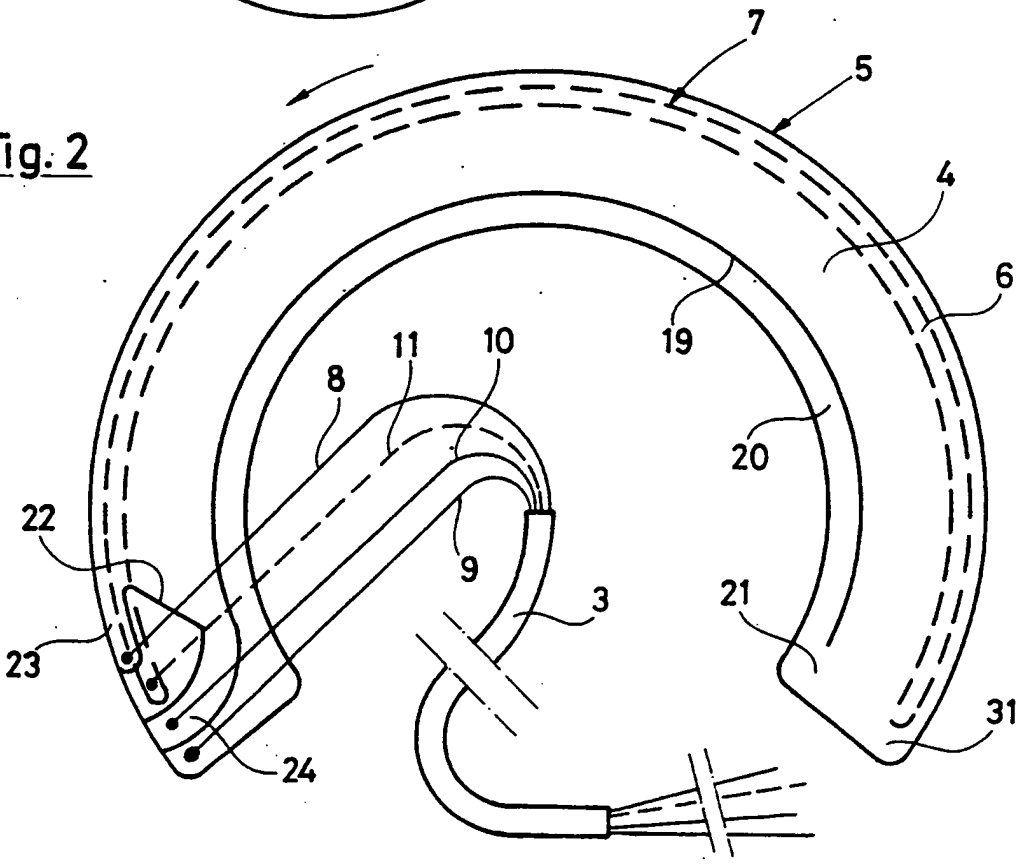
6
4
1
2
3

Fig. 1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24

Fig. 2

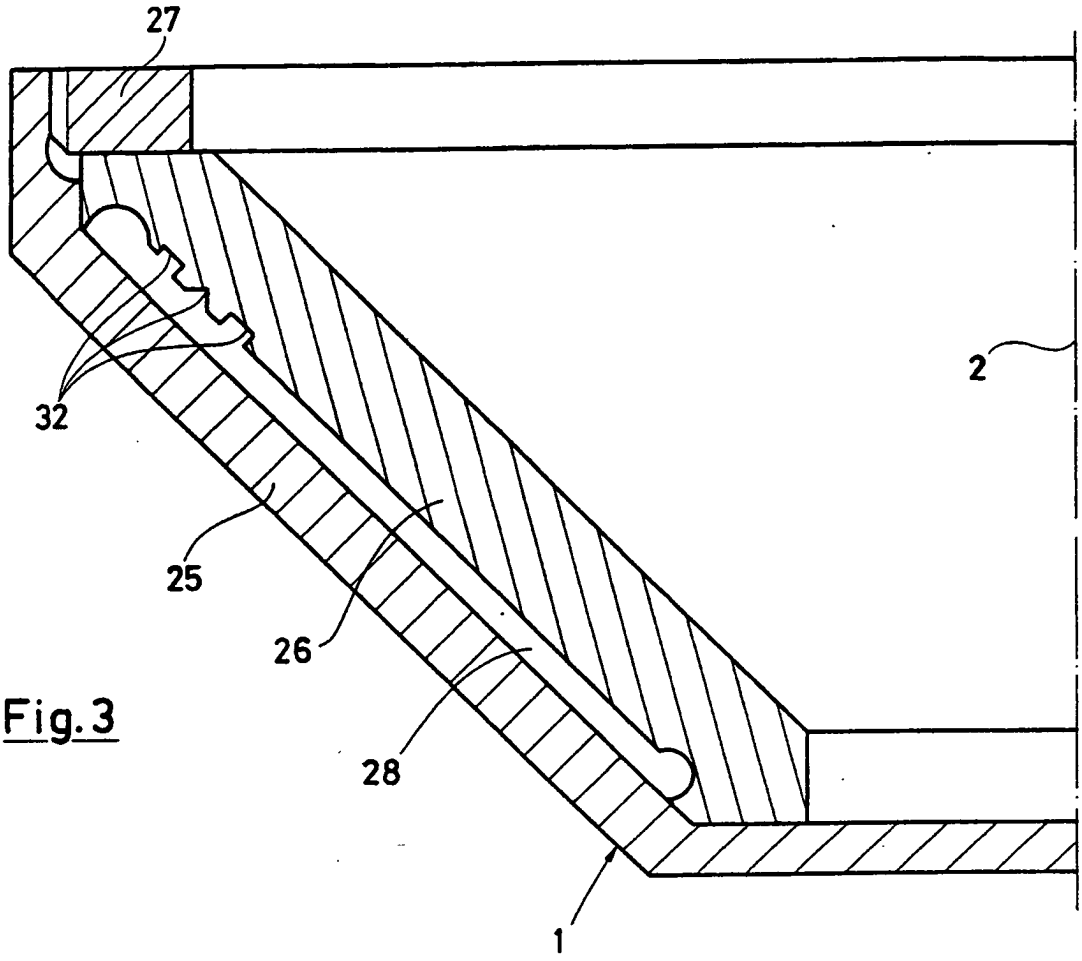


Fig.3

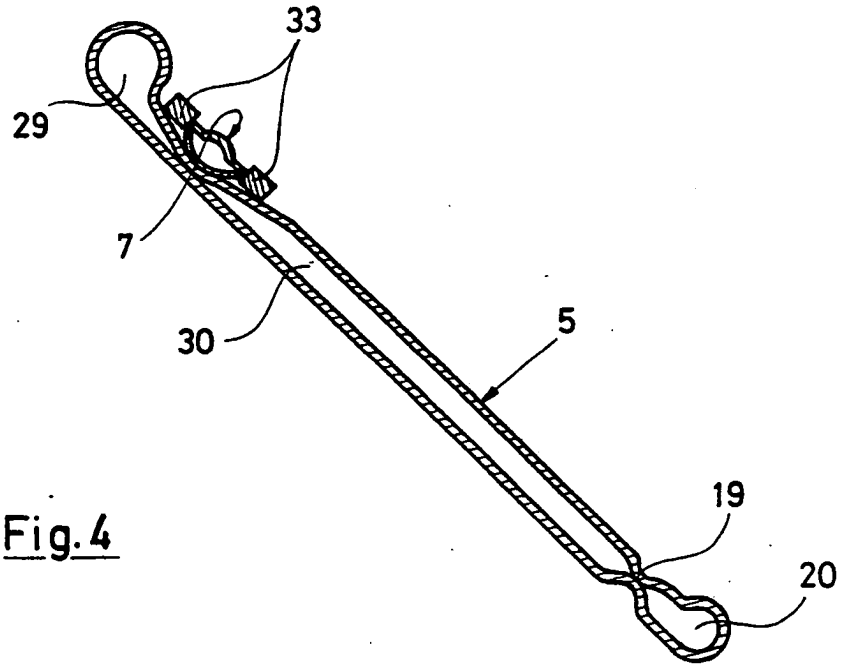


Fig.4

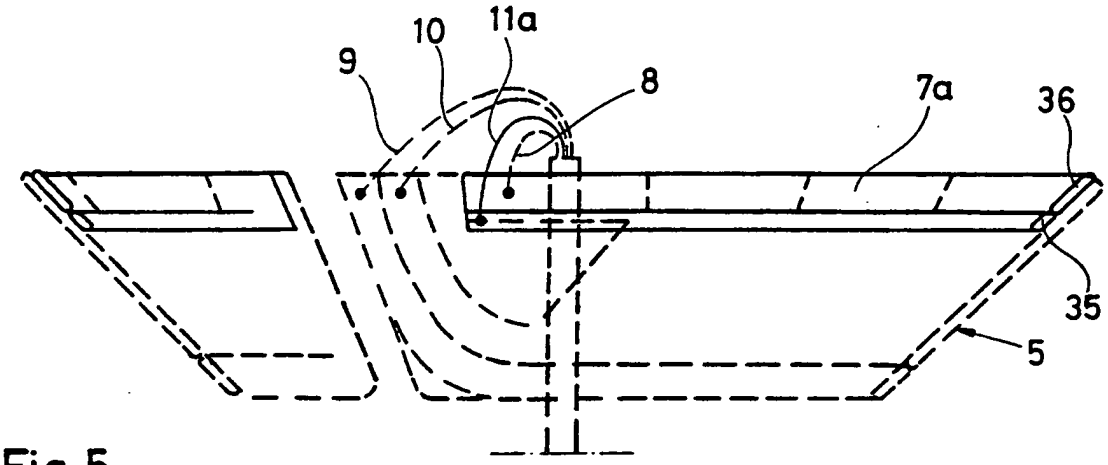


Fig.5

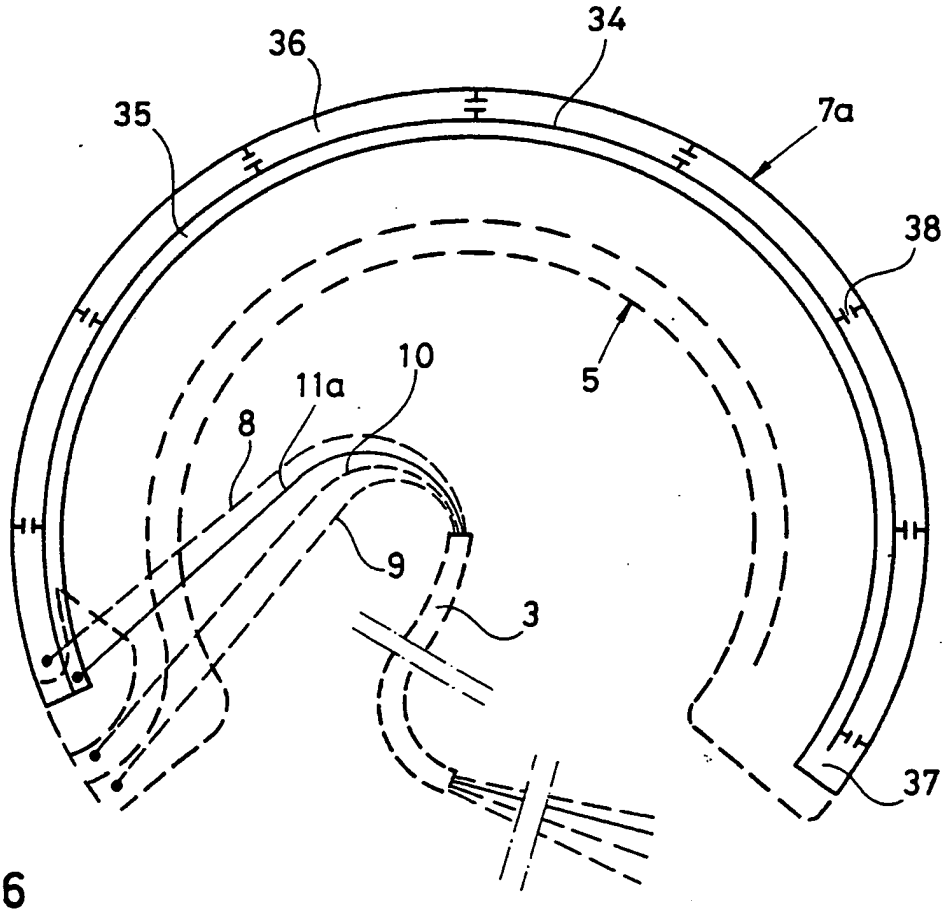


Fig.6

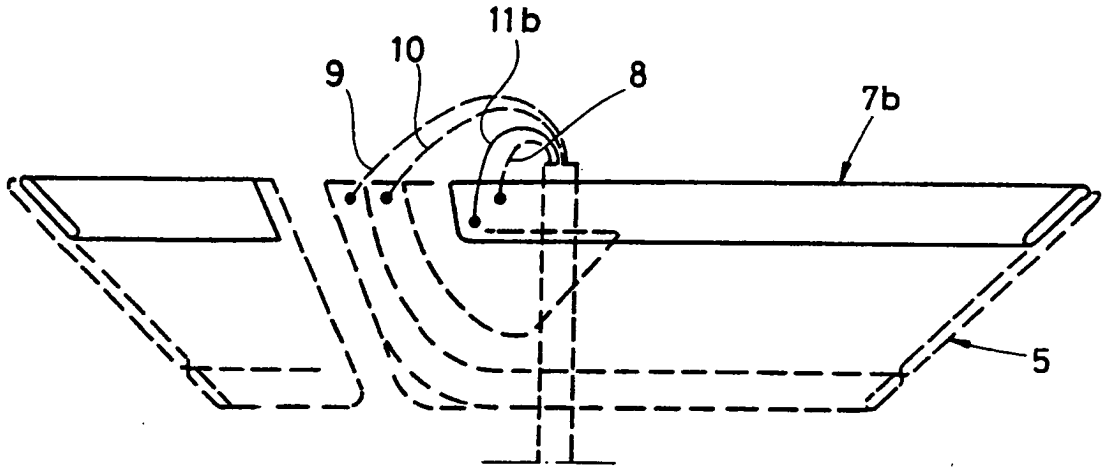


Fig.7

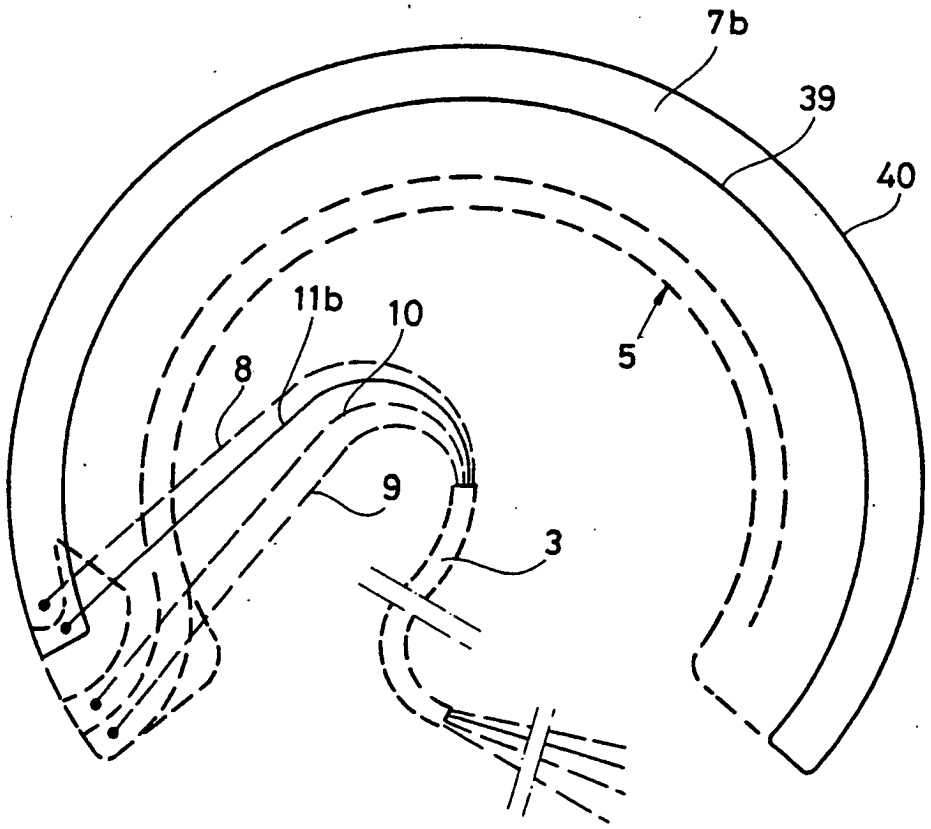
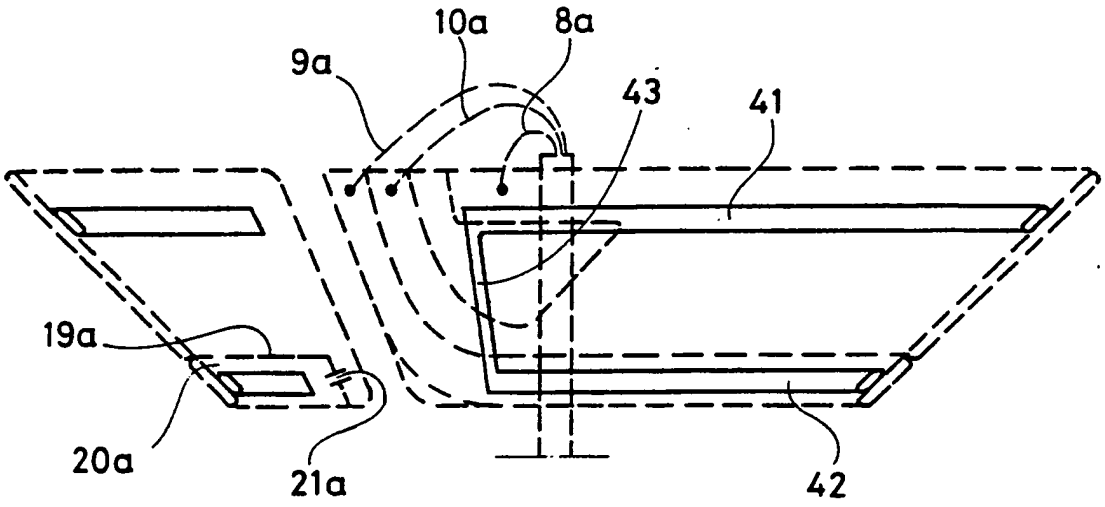


Fig.8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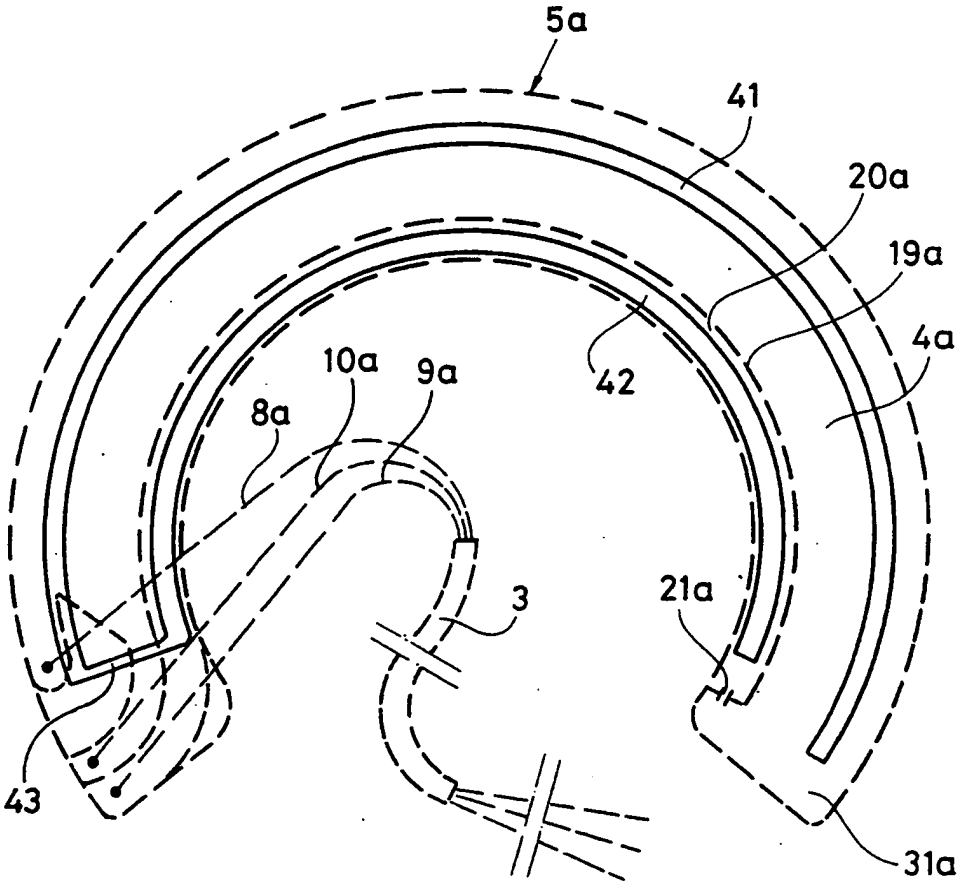
41
19a
20a
21a
42

Fig.9


5a
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20a
19a
4a
10a
9a
42
8a
3
21a
43
31a

Fig.10

INTERNATIONAL SEARCH REPO..T

International Application No PCT/SE88/00312

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

B 04 B 5/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	B 04 B 5/00-5/04
Nat Cl	421:6/01
US Cl	233:1, 12, 14, 16-18, 26, 27, 46; 494:1-85

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	US, A, 3 096 283 (G N HEIN) 2 July 1963 See column 5, line 59- column 6 line 24, fig. 1-3	1-3
Y	US, A, 3 987 961 (SINN ET AL) 26 October 1976 See column 5, line 39- column 6, line 44, fig. 1 & JP, 50107565 DE, 2408206 DE, 24418224 DE, 2404036 FR, 2258898	1-3
A	SE, B, 408 859 (SEPAREX SA) 16 July 1979	1
A	FR, A, 2 404 470 (INTERNATIONAL BUSINESS MACHINES CORPORATION) 27 April 1979	1
A	US, A, 3 239 136 (G N HEIN) 8 March 1966	1

.../...

* Special categories of cited documents: [10]

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1988-10-17	1988 -10- 18
International Searching Authority	**Signature of Authorized Officer** [9]
Swedish Patent Office	Leif Karnsäter

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	US, A, 3 244 363 (G N HEIN) 5 April 1966	1
P	WO, A1, 87/06857 (OMEGA MEDICINTEKNIK AB) 19 November 1987	1